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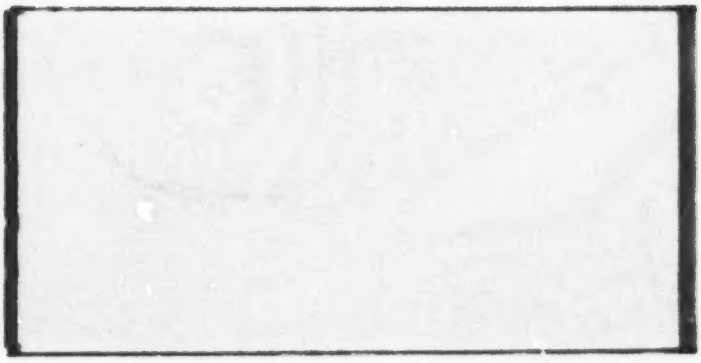

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PICKERING NGS 'B'
INTERIM AQUATIC STUDY, 1983

Report No 84-341-K

W.E. Carey
Biologist
Biological Research Section
Chemical Research Department

ABSTRACT

The status of juvenile and adult fish populations in the vicinity of Pickering NGS 'B' was examined during May, August, November and December, 1983. The distribution and relative abundance of most fish species was similar to that observed in 1982. Brown trout, white perch and gizzard shad were more abundant near the 3 m depth contour of the Pickering NGS 'A' discharge transect. No unusual fish concentrations occurred along the Pickering NGS 'B' discharge transect. A predominantly male aggregation of round whitefish occurred at Thickson Point (4 to 7 m depth contour) on December 8, 1983. No spent female round whitefish were captured. Round whitefish age and growth characteristics resembled those obtained in 1982.

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EXECUTIVE SUMMARY

PICKERING NGS 'B' INTERIM AQUATIC STUDY, 1983

W.E. Carey
Biological Research Section
Chemical Research Department

The overall objective of the Pickering Nuclear Generating Station (NGS) 'B' aquatic studies program is to compare the pre- and postoperational condition of the aquatic environment in the vicinity of Pickering NGS 'B' such that the effects of station construction and operation can be determined. The 1983 commissioning aquatic study was conducted at the request of Design and Development Division in order to maintain continuity between the pre- and postoperational studies.

Results indicated that the fish species composition resembled that of previous studies in the same area. Young-of-the-year alewife and various minnow species dominated beach seine catches, while alewife was the most abundant species in trap and gill net catches. The spatial and temporal distribution of fish species was quite variable. No apparent attraction to the Pickering NGS 'B' discharge area was noted for any fish species. However, gizzard shad, white perch and brown trout showed maximum abundance in the Pickering NGS 'A' discharge area (3 m depth contour). The intrusion of cold upwelled water into the nearshore zone during the August gill netting period allowed some coldwater fish species to move inshore, but the movement of warm water species could not be detected, although their numbers declined during the upwelling period. Fall-spawning round whitefish which aggregated off Thickson Point in December had population characteristics similar to fish captured in previous years.

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To Mr. C.W. Dawson
Section Head
Environmental Sciences and
Technology
Design and Development Division

PICKERING NGS 'B' INTERIM AQUATIC STUDY, 1983

1.0 INTRODUCTION

The second year of a three-year interim aquatic study (1982-1984) was conducted in the vicinity of Pickering NGS 'B' at the request of Environmental Studies and Assessments Department of Design and Development Division. Data gathered during 1983 will form part of a continuous record which may assist in the assessment of the effect of the station on the nearshore environment of Lake Ontario when preoperational (1979-1981) and postoperational (1985-1988) studies are compared.

Pickering NGS 'B' Units 5 and 6 went into service in May, 1983 and February, 1984, respectively. In-service dates for Units 7 and 8 are December 1984 and July 1985, respectively. The following mean daily across-station temperature rises (C°) were recorded during the main field sampling periods.

	Pickering NGS 'A'	Pickering NGS 'B'
May 3-5, 1983	9.6 - 11.2	*
August 9-11, 1983	7.2 - 7.3	0.7 - 4.5
August 15-16, 1983	7.2	4.7
November 1-3, 1983	6.9	0.9 - 1.1

* No data available.

During 1983, aquatic sampling was restricted to the monitoring of juvenile and adult fish in May, August, November and December.

1.1 Objectives

The objectives of the 1983 study were:

1. Determine the distribution and abundance of adult and juvenile fish within the study area.

2. Continue the monitoring of fall-spawning round whitefish in the inshore area near Whitby as initiated in 1981.

1.2 Study Area

The study areas remained the same as those used in 1982 (Figure 1). The four transects within the main study area are Pickering NGS 'A' discharge, Pickering NGS 'B' discharge, Duffin Creek and Simcoe Point. Only two transects, Whitby West and Thickson Point, are contained within the second study area.

2.0 METHODS

2.1 Regular Survey Fishing

Beach seines, trap nets and gill nets were used to sample juvenile and adult fish at each of the four main transects (Figure 1) in May, August and November, 1983.

Triplicate beach seine hauls (one-quarter circle sweeps) were made at night with a 15 m long (6.5 mm mesh size) beach seine near shore at the four locations on May 11, August 18, and November 3, 1983. Pairs of 1.2 m trap nets were set perpendicular to shore lakeward from the 3 m depth for two consecutive 24 h periods per month (May 9-11, August 1-3 and November 1-3, 1983) at each location. Two experimental gill nets, each consisting of eight panels with a mesh size range of 3.8 cm to 12.5 cm in 1.3 cm increments, were set along the bottom perpendicular to shore for two consecutive 24 h periods per month (May 3-5, August 9-11, and November 1-3, 1983) at the 3 m and 12 m depth contours of each location. During August the gill nets set at the 12 m contour locations on the second sampling occasion (August 10) could not be retrieved until 48 h later (August 12) due to poor weather conditions; the second 24 h gill net sets at 3 m contour locations were delayed until August 15-16 since the nets used for the first 24 h period (August 9-10) were clogged with algae.

All fish collected were identified to species and counted. Gill and trap net catches were expressed as the mean catch per unit effort (CUE = catch per single 24 h set), while beach seine catches were reported as catch per three hauls.

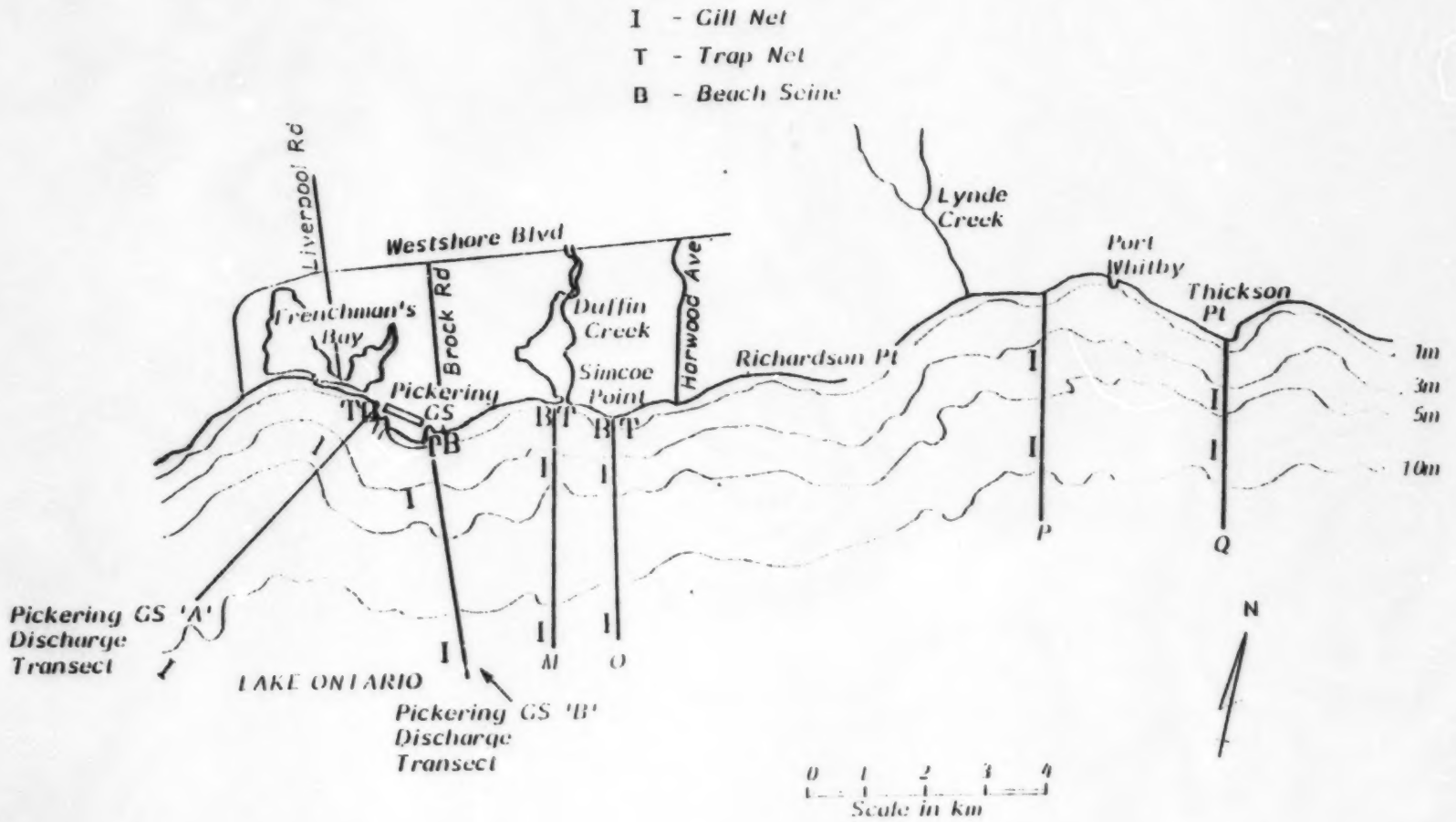

FIGURE 1

FISHING LOCATIONS
PICKERING NGS 'B' INTERIM STUDY, 1983

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Surface water temperatures (°C) at each location were recorded during beach seining and retrieval of trap nets. Surface and bottom temperatures (°C) were recorded during setting and retrieval of gill nets at all locations (3 m and 12 m contours) sampled. A Hydrolab 2000 meter was used to determine temperatures. In addition, continuous hourly temperature records were obtained at some fishing locations during the fishing intervals, by means of thermographs supplied by Hydraulic Studies Department. Thermographs were placed at the inshore and offshore ends of the gill nets set at the 3 m contour and at the inshore end of the gill nets set at the 12 m contour about 0.5 m from the bottom. During the May and November fishing periods three thermographs each were located along the Pickering NGS 'B' discharge and Simcoe Point transects, while during the August fishing period, three thermographs each were located along the Pickering NGS 'A' discharge and Duffin Creek transects. The purpose of obtaining continuous temperature records was to determine plume-induced water temperature alterations and identify any upwelling episodes that occurred during the gill net fishing periods. Temperature data derived from thermographs maintained at non-fishing locations throughout the May-November period were used to verify the occurrence of upwelling events.

2.2 Fall-Spawning Fish Survey

Experimental gill nets (same dimensions as above) were set for three 24 h periods during the fall, with nets being retrieved on December 8, 9 and 14, 1983 from the 3 m and 7 m contours of the Whitby West and Thickson Point transects (Figure 1). The fall fishing program was initiated when the ambient water temperature (measured at the Oshawa Water Supply Plant intake) was approximately 4 to 5°C, since the majority of ripe adult round whitefish occur inshore at temperatures below 5° C (Ontario Hydro Research Division Report No 82-539-K). Surface and bottom water temperatures were obtained before and after each gill net set. All salmonids and coregonids captured alive were released.

Fork lengths (mm) and weights (g) were measured and scale samples collected for all salmonids and coregonids captured in 1983. Salmonid scales were sent to the Ministry of Natural Resources (MNR) for ageing to supplement their data base on Lake Ontario salmonids. Coregonid scales were used in age and growth determinations. The sex and spawning condition of each round whitefish captured during the fall-spawning survey was determined. Stomachs of a few representative round whitefish (n = 5) and white sucker (n = 7) were examined for evidence of round whitefish eggs.

3.0 RESULTS AND DISCUSSION

3.1 Regular Survey Fishing

Detailed gill and trap net catch data are contained in Appendix 1. Common and scientific names of all fish species captured at Pickering NGS 'B' in 1983 are listed in Appendix 2.

3.1.1 Beach Seines

Night beach seining efforts resulted in the capture of 295 fish representing 18 species (Table 1). Alewife were caught in the highest numbers (46%) followed by longnose dace (16%) and spottail shiner (8%) (Table 1). The balance of the overall beach seine catch consisted mainly of a mixture of common littoral zone fish species including several cyprinids. One each of white bass, rainbow trout and brown trout were also taken (Table 1).

Alewife caught in beach seines were all young-of-the-year fish. They were only obtained in hauls made on August 18 near Duffin Creek (38 fish) and in the vicinity of Pickering NGS 'A' discharge (97 fish) (Table 2). Recorded water temperatures at these two locations were 22°C and 24°C, respectively. Therefore it is unlikely that the beach area close to Pickering NGS 'A' discharge was any more attractive for young-of-the-year alewife than the Duffin Creek area on August 18, 1983. The fact that no young-of-the-year alewife were collected in the August 30, 1982 beach seine samples (Ontario Hydro Research Division (OHRD) Report No 83-435-K) but were collected on August 18, 1983 is consistent with life history data indicating that young-of-the-year alewife migrate to deep waters during late August or early September (Scott and Crossman, 1973).

Longnose dace were taken in largest numbers at the Simcoe Point transect in August (Table 2). Beach seine catches of other species were small and, except for a catch of 15 johnny darter near Duffin Creek on May 11, were not concentrated at a particular location or time. Some of the rainbow smelt collected at the Duffin Creek transect in May and a few of the longnose dace caught at the Simcoe Point and Duffin Creek transects in August were young-of-the-year fish which were probably produced in the Duffin Creek area.

Notable fish species captured in beach seines near the Pickering NGS 'B' discharge in May were a juvenile rainbow trout (~20 cm long), an adult brown trout (~1.4 kg) and a juvenile white bass (~10 cm long). All three fish were released shortly after capture. These piscivorous species may frequent shallow inshore waters at night to feed and their occurrence

Table 1

Pickering NGS 'B' 1983 Total Fish Catch Summary

	Beach Seine		Trap Net		Gill Net		Total Catch	
	#	%	#	%	#	%	#	%
Alewife	135	45.76	3 492	79.29	6 585	84.40	10 212	81.69
Brown Bullhead	0	0.00	648	14.71	18	0.23	666	5.33
White Sucker	4	1.36	170	3.86	314	4.02	488	3.90
Rainbow Smelt	12	4.07	3	0.07	307	3.93	322	2.58
Gizzard Shad	2	0.68	4	0.09	168	2.15	174	1.39
Lake Trout	0	0.00	0	0.00	103	1.32	103	0.82
Yellow Perch	1	0.34	15	0.34	67	0.86	83	0.66
Brown Trout	1	0.34	0	0.00	79	1.01	80	0.64
White Perch	0	0.00	27	0.61	49	0.63	76	0.61
Round Whitefish	0	0.00	0	0.00	52	0.67	52	0.42
Longnose Dace	47	15.93	0	0.00	0	0.00	47	0.38
Carp	1	0.34	18	0.41	7	0.09	26	0.21
Spottail Shiner	24	8.14	0	0.00	0	0.00	24	0.19
White Bass	1	0.34	6	0.14	11	0.14	18	0.14
Johnny Darter	17	5.76	0	0.00	0	0.00	17	0.14
Smallmouth Bass	0	0.00	7	0.16	8	0.10	15	0.12
Fathead Minnow	14	4.75	0	0.00	0	0.00	14	0.11
Rainbow Trout	1	0.34	0	0.00	12	0.15	13	0.10
Pumpkinseed	8	2.71	4	0.09	0	0.00	12	0.10
Logperch	10	3.39	0	0.00	0	0.00	10	0.08
Lake Whitefish	0	0.00	0	0.00	8	0.10	8	0.06
Emerald Shiner	8	2.71	0	0.00	0	0.00	8	0.06
Rock Bass	0	0.00	5	0.11	1	0.01	6	0.05
Walleye	0	0.00	2	0.05	3	0.04	5	0.04
Slimy Sculpin	5	1.69	0	0.00	0	0.00	5	0.04
Bluntnose Minnow	4	1.36	0	0.00	0	0.00	4	0.03
Longnose Sucker	0	0.00	0	0.00	3	0.04	3	0.02
Lake Chub	0	0.00	0	0.00	2	0.03	2	0.02
Eel (American)	0	0.00	2	0.05	0	0.00	2	0.02
Freshwater Drum	0	0.00	0	0.00	2	0.03	2	0.02
Coho Salmon	0	0.00	0	0.00	1	0.01	1	0.01
Chinook Salmon	0	0.00	0	0.00	1	0.01	1	0.01
Northern Pike	0	0.00	0	0.00	1	0.01	1	0.01
Black Crappie	0	0.00	1	0.02	0	0.00	1	0.01
Total (# of Species)	295 (18)		4 404 (15)		7 802 (23)		12 501 (34)	

TABLE 2

Beach Seine Catch Per Three Hauls:
Pickering NGS 'B' - 1983

LOCATION DATE	PKA 05/11	PKA 08/18	PKA 11/03	PKB 05/11	PKB 08/18	PKB 11/03	PKDC 05/11	PKDC 08/11	PKDC 11/03	PKS 05/11	PKS 08/18	PKS 11/03
ALEWIFE	0	97	0	0	0	0	0	38	0	0	0	0
GIZZARD SHAD	0	0	0	0	0	0	0	2	0	0	0	0
RAINBOW TROUT	0	0	0	1	0	0	0	0	0	0	0	0
BROWN TROUT	0	0	0	1	0	0	0	0	0	0	0	0
RAINBOW SMELT	0	0	0	3	0	0	8	1	0	0	0	0
WHITE SUCKER	0	1	0	2	0	0	1	0	0	0	0	0
CARP	0	0	0	0	0	1	0	0	0	0	0	0
EMERALD SHINER	0	1	1	0	0	2	0	0	3	0	0	1
SPOTTAIL SHINER	1	7	0	0	0	0	9	0	6	0	0	1
BLUNTNOSE MINNOW	0	0	1	2	0	1	0	0	0	0	0	0
FATHEAD MINNOW	0	1	0	0	0	0	0	7	5	0	1	0
LONGNOSE DACE	1	3	2	1	0	1	3	8	0	3	24	1
WHITE BASS	0	0	0	1	0	0	0	0	0	0	0	0
PUMPKINSEED	0	2	0	0	0	0	0	1	3	0	1	1
YELLOW PERCH	0	1	0	0	0	0	0	0	0	0	0	0
JOHNNY DARTER	0	0	0	0	0	0	15	2	0	0	0	0
LOG PERCH	0	6	0	0	0	0	0	3	0	0	1	0
SLIMY SCULPIN	0	0	0	0	0	0	2	0	0	0	0	3

PKA Pickering NGS 'A' Discharge Transect
PKB Pickering NGS 'B' Discharge Transect
PKDC Duffin Creek Transect
PKS Simcoe Point Transect

near the Pickering NGS 'B' discharge area during the spring should not necessarily be interpreted as an attraction to the Pickering NGS 'B' discharge plume, which was about 2°C warmer than non-thermal locations sampled in May.

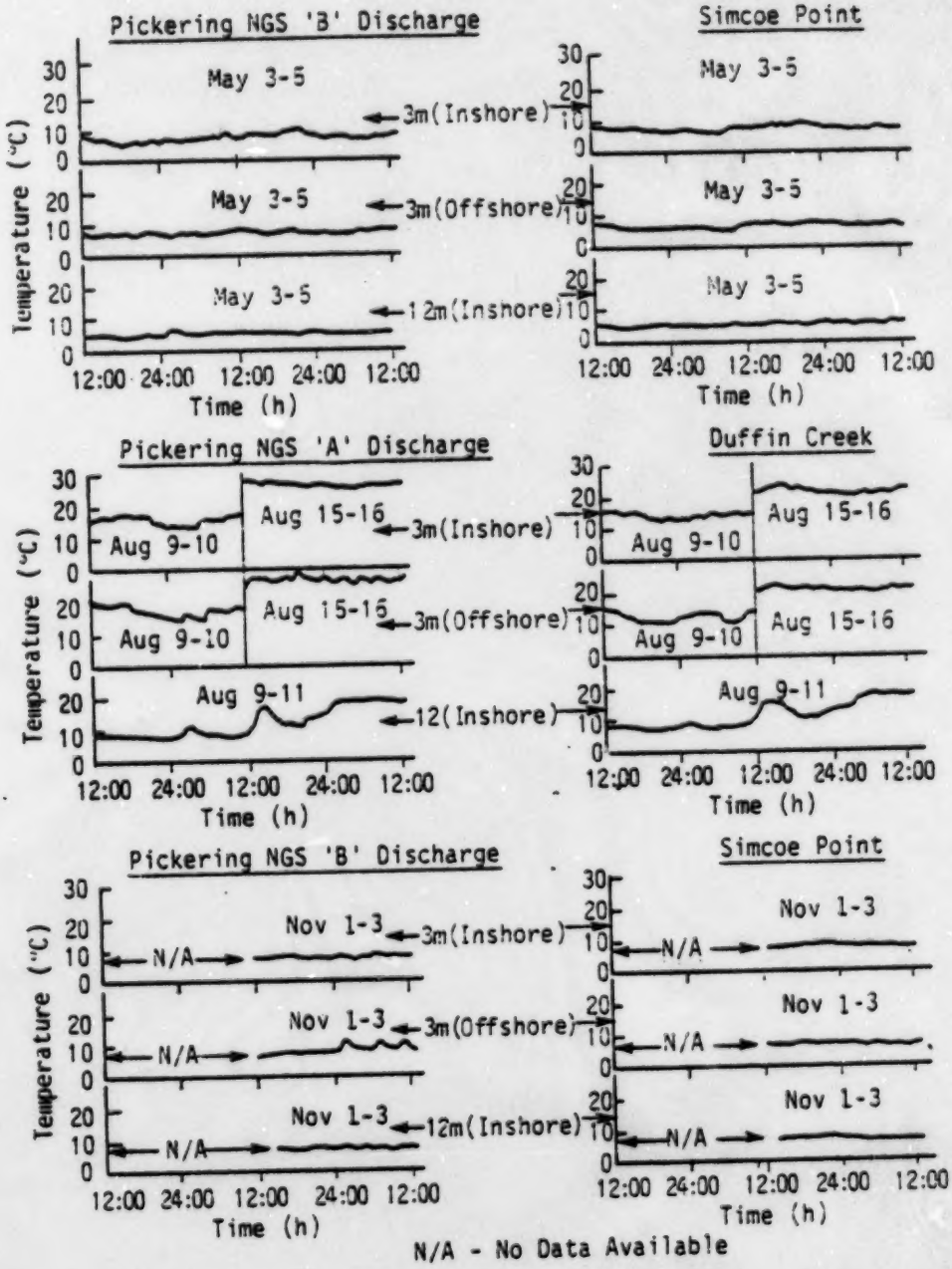
3.1.2 Gill Nets and Trap Nets

Alewife was the dominant fish species captured in both gill and trap nets (Table 1). Brown bullhead and white sucker were second and third in overall abundance in trap net catches. White sucker, rainbow smelt, gizzard shad and lake trout were prominent in gill net catches (Table 1). A total of 4 404 fish of 15 species was captured in trap nets while 7 802 fish of 23 species were taken in gill nets (Table 1).

In order to assist in characterizing fish spatial and temporal distribution in the study area the temperature regime existing during gill net fishing periods will be described prior to the detailed discussion of fish distribution. Continuous temperature records obtained during the May gill net fishing session show that bottom temperatures along the Pickering NGS 'B' discharge transect were quite similar to those observed along the Simcoe Point transect (Figure 2). Temperatures at the 3 m depth contour ranged from 5 - 9°C while temperatures at the 12 m depth contour were about 5°C at both locations.

The temperature structure observed during the second fishing interval indicated that an intense upwelling event occurred on August 9 -10, 1983 (Figure 2). Inshore (3 m contour) temperatures at both Pickering NGS 'A' and Duffin Creek transects were well below seasonal levels, and dropped to about 14°C and 11°C, respectively, at the two locations. One week later (August 15 - - 16) bottom temperatures were about 10°C higher in shallow (3 m contour) waters near the Pickering NGS 'A' discharge and about 7 - 8°C higher in the Duffin Creek inshore area (Figure 2). It is noteworthy that during the upwelling episode the inshore area of Pickering NGS 'A' discharge (3 m contour) was still approximately 3°C warmer than the Duffin Creek area.

The offshore bottom thermal regime (12 m contour) was similar at both Pickering NGS 'A' discharge and Duffin Creek transects, with temperatures near 9°C recorded during the upwelling. Gill nets were set at the 12 m contour for two consecutive 24 h periods. Temperatures gradually increased during the second 24 h period, indicating the end of the upwelling event (Figure 2).



N/A - No Data Available

FIGURE 2

HOURLY BOTTOM TEMPERATURES RECORDED AT INSHORE AND OFFSHORE ENDS OF GILL NETS IN MAY, AUGUST AND NOVEMBER, 1983

Further evidence of the upwelling is provided by continuous temperature records for the period August 6 - 15, 1983 extracted from thermographs located at the Pickering NGS 'A' discharge (4.5 m) and the Pickering NGS 'B' discharge (12.0 m) (Table 3). The data clearly show a rapid drop in bottom temperatures at these locations beginning on August 8 (shortly after gill nets were set). The upwelling lasted about 48 h (Table 3).

Normal temperatures were observed at the locations examined during the November gill net fishing period (Figure 2).

Spatial and Temporal Fish Distribution

The fish species discussed in this section are those which were either caught in large numbers (alewife, brown bullhead, white sucker, rainbow smelt and gizzard shad) or occurred in moderate numbers and are of potential importance (lake trout, brown trout, white perch and round whitefish).

Alewife

The catch per unit effort (catch per 24 h net set = CUE) of alewife in gill nets was significantly higher ($P < 0.05$) in May than in other months sampled, and significantly greater ($P < 0.05$) at the 3 m depth contour sampling locations than at deeper (12 m depth contour) locations (Table 4; Appendix 3). However, significant ($P < 0.05$) first- and second-order interactions occurred, indicating that observed trends were not consistent (Appendix 3). Although differences among catches at the four sampling transects were not statistically significant, CUE values at the 3 m depth contour in May ranged from 222.0 at the Pickering NGS 'B' discharge transect to 1140.5 at the Duffin Creek transect.

Alewife distribution in trap nets differed from that in gill nets. The May catch per 24 h trap net set was highest at the Pickering NGS 'A' discharge transect (CUE = 609.8) and lowest at the Duffin Creek transect (CUE = 6.5) (Table 5). Both month and location of capture were significant ($P < 0.05$) in a two-way ANOVA test but a significant ($P < 0.05$) location x month interaction also occurred (Appendix 3).

Raw trap net catch data show that larger alewife catches consistently occurred in the more easterly of the two nets set at each transect during May (Appendix 1a). This result may mean that alewife were migrating along shore in an east to west direction during the May fishing period. The high CUE values observed at the Duffin Creek transect (in gill nets) and at the Pickering NGS 'A' discharge transect (in trap nets) suggest that alewife were concentrated at these locations during May.

Table 3

Bottom Temperatures (6 h Means in °C) Recorded From August 6-15, 1983 (i) Off Pickering NGS 'A' Discharge (4.5 m Depth in 5.0 m of Water) and (ii) Off Pickering NGS 'B' Discharge (12.0 Depth in 12.5 m of Water)

Date	Pickering NGS 'A' Discharge (THB36-4.5)				Pickering NGS 'B' Discharge (TH06-12.0)			
	Period 1 (0100-0600 h)	Period 2 (0700-1200 h)	Period 3 (1300-1800 h)	Period 4 (1900-2400 h)	Period 1 (0100-0600 h)	Period 2 (0700-1200 h)	Period 3 (1300-1800 h)	Period 4 (1900-2400 h)
August 6	20.2	19.8	22.1	21.5	19.1	18.4	16.6	16.2
7	18.1	18.8	21.0	19.5	16.7	17.3	16.7	17.1
8	18.6	20.8	18.2	15.2	15.1	15.5	15.3	9.7
9	12.9	12.4	14.3	13.3	8.9	9.4	8.3	8.1
10	12.8	10.8	16.8	16.3	8.9	8.9	14.2	13.0
11	16.1	16.6	16.9	17.2	16.5	17.8	18.6	18.8
12	17.4	17.6	17.6	17.8	18.7	19.2	19.3	19.6
13	18.6	19.4	20.5	21.3	19.9	20.1	20.2	20.8
14	20.8	20.5	20.9	21.5	21.0	20.9	21.1	21.1
15	20.7	20.4	20.6	20.7	21.1	21.1	21.1	21.0

- Portion underlined indicates an upwelling event.

TABLE 4

Gill Net Catch Per 24 h Set:
Pickering NGS 'B' - 1983

LOCATION	PKA12	PKA12	PKA12	PKA3	PKA3	PKA3	PKB12	PKB12	PKB12	PKB3	PKB3	PKB3
DATE (MONTH)	05	08	11	05	08	11	05	08	11	05	08	11
ALEWIFE	161.5	38.0	0.0	413.0	0.0	0.0	216.5	51.0	1.0	222.0	9.5	0.5
GIZZARD SHAD	0.0	0.0	0.0	0.0	0.0	71.0	0.0	0.0	0.0	0.0	1.0	3.5
COHO SALMON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
RAINBOW TROUT	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5
BROWN TROUT	0.0	0.8	0.5	11.5	0.0	0.0	0.0	0.0	1.0	1.0	0.0	6.0
LAKE TROUT	4.0	0.8	0.5	7.5	0.0	1.0	1.5	4.0	1.0	1.5	0.0	3.5
LAKE WHITEFISH	0.5	0.0	0.0	1.5	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0
ROUND WHITEFISH	3.5	7.5	0.5	2.5	0.0	1.5	0.0	0.0	0.5	0.5	0.0	0.0
RAINBOW SMELT	6.0	10.3	0.0	10.5	0.0	0.0	11.5	4.5	0.0	0.0	0.0	0.0
NORTHERN PIKE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
WHITE SUCKER	1.0	3.8	2.5	7.5	1.5	2.5	1.5	2.8	1.5	0.5	5.5	7.0
LAKE CHUB	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CARP	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0
BROWN BULLHEAD	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITE PERCH	0.0	0.0	0.0	4.5	5.0	2.5	0.0	0.0	0.5	0.0	4.0	2.0
WHITE BASS	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
SMALLMOUTH BASS	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOW PERCH	0.0	0.0	0.0	1.5	0.5	5.0	0.0	0.3	0.0	0.0	8.5	7.0
WALLEYE	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
FRESHWATER DRUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0

LOCATION	PKDC12	PKDC12	PKDC12	PKDC3	PKDC3	PKDC3	PKS12	PKS12	PKS12	PKS3	PKS3	PKS3
DATE (MONTH)	05	08	11	05	08	11	05	08	11	05	08	11
ALEWIFE	149.0	14.8	1.0	1140.5	32.0	1.0	104.0	43.0	3.0	583.0	64.0	0.5
GIZZARD SHAD	0.0	0.0	0.0	0.0	6.0	0.0	0.0	1.0	0.0	0.0	1.5	0.0
CHINOOK SALMON	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW TROUT	0.0	0.3	0.0	0.0	1.0	2.0	0.0	0.3	0.0	0.0	0.0	0.5
BROWN TROUT	0.0	0.5	1.0	1.0	1.0	7.5	0.0	0.3	0.5	1.0	0.0	4.5
LAKE TROUT	3.0	2.0	2.5	0.5	0.5	1.0	1.0	3.0	1.5	2.5	0.0	7.5
LAKE WHITEFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
ROUND WHITEFISH	1.0	1.0	1.5	0.0	0.0	0.5	0.5	1.5	0.5	0.5	0.0	2.5
RAINBOW SMELT	27.0	0.8	0.0	22.0	0.0	0.5	21.0	4.3	0.0	22.0	0.0	0.0
LONGNOSE SUCKER	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
WHITE SUCKER	1.0	1.8	2.5	20.5	25.0	23.0	0.0	4.3	1.5	11.5	10.0	6.0
LAKE CHUB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0
CARP	0.0	0.0	0.5	0.0	1.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
BROWN BULLHEAD	0.0	0.3	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	4.5	0.0
WHITE PERCH	1.5	0.5	0.5	0.5	0.5	1.5	0.0	0.0	0.0	0.0	0.0	1.0
WHITE BASS	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.5	2.0
ROCK BASS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
SMALLMOUTH BASS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
YELLOW PERCH	0.5	0.0	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.5	4.0	0.0
WALLEYE	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
FRESHWATER DRUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0

PKA3 Pickering NGS 'A' Discharge 3 m Contour
PKA12 Pickering NGS 'A' Discharge 12 m Contour
PKB3 Pickering NGS 'B' Discharge 3 m Contour
PKB12 Pickering NGS 'B' Discharge 12 m Contour
PKDC3 Duffin Creek 3 m Contour
PKDC12 Duffin Creek 12 m Contour
PKS3 Simcoe Point 3 m Contour
PKS12 Simcoe Point 12 m Contour

TABLE 5

Trap Net Catch Per 24 h Set:
Pickering NGS 'B' - 1983

LOCATION	PKA	PKA	PKA	PKB	PKB	PKB	PKDC	PKDC	PKDC	PKS	PKS	PKS
DATE (MONTH)	05	08	11	05	08	11	05	08	11	05	08	11
ALEWIFE	609.8	4.3	0.0	102.7	5.5	0.0	6.5	24.8	0.0	109.8	9.8	0.0
GIZZARD SHAD	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.3	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3
WHITE SUCKER	9.8	0.3	1.8	2.0	3.8	0.0	2.8	2.8	9.3	6.8	0.8	3.7
CARP	0.0	0.0	1.0	0.0	0.0	0.0	0.0	2.3	0.8	0.0	0.5	0.0
BROWN BULLHEAD	2.8	42.5	20.3	1.0	16.0	0.0	6.0	23.5	1.3	9.8	37.8	1.7
EEL (AMERICAN)	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITE PERCH	0.0	3.3	2.3	0.0	0.3	0.0	0.0	0.3	0.5	0.0	0.3	0.0
WHITE BASS	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
ROCK BASS	0.0	0.0	0.5	0.0	0.3	0.0	0.3	0.0	0.0	0.3	0.0	0.0
PUMPKINSEED	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMALLMOUTH BASS	0.0	1.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0
BLACK CRAPPIE	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOW PERCH	0.0	0.3	1.5	0.0	0.5	0.0	0.0	0.8	0.5	0.3	0.0	0.0
WALLEYE	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0

PKA Pickering NGS 'A' Discharge Transect
PKB Pickering NGS 'B' Discharge Transect
PKDC Duffin Creek Transect
PKS Simcoe Point Transect

Brown Bullhead

This species was captured mainly in trap nets. The largest trap net CUE of brown bullhead occurred at the Pickering NGS 'A' discharge transect in August (CUE = 42.5) (Table 5). No significant differences ($P > 0.05$) were noted among locations, but August catches were significantly greater ($P < 0.05$) than catches in other months (Appendix 3).

White Sucker

The maximum gill net CUE of white sucker occurred at the Duffin Creek transect in August (CUE = 25.0) (Table 4). Catches were also high at Duffin Creek in May and November. Inshore gill net catches (3 m depth contour) were significantly greater ($P < 0.05$) than offshore catches (12 m depth contour) although there was a significant ($P < 0.05$) location x depth interaction (Appendix 3). Trap net CUE values for white sucker were generally low, with the maximum value recorded at the Pickering NGS 'A' discharge transect in May (9.8) (Table 5). No significant differences ($P < 0.05$) were detected among trap net CUE values (Appendix 3).

Rainbow Smelt

Very few rainbow smelt were taken in trap nets (Table 5). Significantly ($P < 0.05$) more rainbow smelt were captured by gill nets in May than during other fishing periods (Appendix 3). The maximum gill net CUE occurred at the 12 m depth contour of the Duffin Creek transect in May (CUE = 27.0) (Table 4).

Gizzard Shad

The only substantial catch of gizzard shad was made with gill nets at the 3 m depth contour of the Pickering NGS 'A' discharge transect during November (CUE = 71.0) (Table 4). Despite this large CUE value, no significant ($P < 0.05$) differences were noted among the catch data (Appendix 3). However the concentration of gizzard shad at the Pickering NGS 'A' discharge transect is consistent with previous observations made during the fall and winter period (OHRD Report Nos 83-372-K and 83-435-K). It is likely that gizzard shad began to accumulate in the discharge area as ambient lake temperatures declined, since this species prefers a water temperature of about 19 - 20°C (Reutter and Herdendorf, 1976).

White Perch

White perch were captured by gill nets in significantly ($P < 0.05$) greater numbers along the 3 m depth contour rather than the 12 m depth contour sampling locations (Table 4; Appendix 3). However, this trend was not completely consistent since a significant ($P < 0.05$) location x depth interaction existed (Appendix 3). White perch CUE in trap nets was significantly ($P < 0.05$) greater at the Pickering NGS 'A' discharge transect than at other locations sampled (Table 5; Appendix 3). These results are similar to those obtained in 1982 (OHRD Report No 83-435-K).

Brown Trout

The gill net CUE of brown trout was highest at the 3 m depth contour of the Pickering NGS 'A' discharge transect in May (CUE = 11.5) (Table 4). The maximum catches recorded at other locations occurred along the 3 m depth contour in November (Table 4). There were significant ($P < 0.05$) differences among catches according to location, depth and date of sampling. However, significant ($P < 0.05$) interactions also occurred, indicating that the observed distribution patterns were not consistent (Appendix 3). It is noteworthy that both the overall brown trout catch in gill nets (79 fish; Table 1) and the maximum CUE of brown trout (CUE = 11.5; Table 4) were approximately double the corresponding 1982 catches (35 and 6.5, respectively; OHRD Report No 83-435-K). This trend is consistent with the fact that the total number of juvenile brown trout stocked into Lake Ontario has increased in recent years (OMNR, 1983). Subsequent fish catch data should be examined carefully to determine whether any further increase in brown trout CUE occurs at this location or along the Pickering NGS 'B' discharge transect.

Lake Trout

No significant differences ($P > 0.05$) were noted among catches of lake trout with respect to location, date or depth of capture, although location x date and depth x date interaction terms were significant ($P < 0.05$) (Appendix 3). The highest gill net CUE (7.5) was obtained at two locations: at the 3 m depth contour of the Pickering NGS 'A' discharge transect in May and at the 3 m depth contour of the Simcoe Point transect in November (Table 4). The CUE data does not suggest that lake trout frequented either of the thermal discharge locations to a greater extent than other shoreline areas.

Round Whitefish

The temporal and spatial distributions of round whitefish in gill nets were uneven, with no significant trends observed in the CUE data (Table 4; Appendix 3). The maximum gill net CUE of round whitefish (7.5) occurred at the 12 m depth contour of the Pickering NGS 'A' discharge transect during August (Table 4). Catches of round whitefish were higher at the 12 m depth contour rather than the 3 m depth contour of both Duffin Creek and Pickering NGS 'A' discharge transects (Table 4).

All Species

The Pickering NGS 'B' discharge area did not appear to attract fish to any greater extent than other locations sampled. Thus the operation of Unit 5 at Pickering NGS 'B' did not alter shoreline fish distribution in this region in 1983. However, three fish species showed maximum abundance (CUE) in the Pickering NGS 'A' discharge nearshore area (3 m depth contour). These were gizzard shad (November), white perch (August) and brown trout (May). The higher degree of thermal enrichment from Pickering NGS 'A' during fishing periods (see introduction) likely accounted for the difference in distribution of white perch and gizzard shad between the two discharge locations. There is also a possibility that the presence of brown trout in the Pickering NGS 'A' discharge area was related to thermal preference characteristics. The bottom temperature recorded during the period of maximum brown trout abundance in Pickering NGS 'A' discharge (3 m contour) was 13.0°C (Appendix 4), which is within the range preferred by adult brown trout (EPRI, 1981; Haynes, 1983). Previous studies have also shown that brown trout were more abundant in the Pickering NGS 'A' discharge area that at other shoreline locations during May (OHRD Report Nos 82-460-K, 83-193-K and 83-435-K).

The distribution of fish species (except alewife and rainbow smelt) in gill nets during and shortly after the August 8-10 upwelling period is presented in Table 6. It is apparent that cold water species (salmonids and coregonids) were more prevalent at 12 m depth contour locations than at 3 m depth contour locations. Overall, slightly more cold water species occurred at the 12 m depth contour locations during rather than after the upwelling. Round whitefish and lake trout were the only species found at the 12 m depth contour locations during the upwelling, while some warm water species (mainly white sucker) as well as cold water species occurred at these locations after the upwelling episode (Table 6). These results suggest that warm water species moved away from the 12 m depth contour locations while some cold water species possibly moved inshore with the cold upwelled water.

Table 6

Fish Distribution in Gill Nets (Excluding Alewife and Smelt) Near Pickering NGS During (August 10) and After (August 12 and 16) an Upwelling

	August 10				August 16		August 12	
	3 m Depth Contour		12 m Depth Contour		3 m Depth Contour		12 m Depth Contour	
	WW	CW	WW	CW	WW	CW	WW	CW
Pickering NGS 'A' Discharge Transect	5 (3 WS; 2 BB)	0	0	15 (14 RWF; 1 LT)	21 (1 BB; 2 WB; 10 WP; 7 SMB; 1 YP)	0	15 (WS)	6 (3 BT; 1 LT; 2 RWF)
Pickering NGS 'B' Discharge Transect	14 (3 WP; 2 YP; 8 WS; 1 GZS)	0	0	7 (LT)	24 (1 GZS; 5 WP; 3 WS; 15 YP)	1 (RBT)	12 (11 WS;	4 (2 LWF: 2 LT)
Duffin Creek Transect	54 (48 WS; 5 YP; 1 CP)	4 (1 RBT; 2 BT; 1 LT)	1 (WP)	5 (4 LT; 1 RWF)	28 (12 GZS; 6 YP; 5 BB; 2 CP; 2 WS; 1 WP)	1 (RBT)	8 (7 WS; 1BB)	5 (1BT; 1 RBT; 2 RWF; 1 CS)
Simcoe Point Transect	22 (16 WS; 4 YP; 1 BB; 1 GZS)	0	2 GZS	5 (LT)	20 (4 YP; 8 BB; 4 WS; 2 GZS; 1 WB; 1 FWD)	0	17 (WS)	11 (1 BT; 6 RWF; 2 LT; 1 RBT; 1 LWF)
Totals	95	4	3	32	93	2	52	26

WW = warm water species
CW = cold water species

WS = white sucker
YP = yellow perch
CP = carp
BB = brown bullhead
SMB = smallmouth bass
CS = chinook salmon
RWF = round whitefish
BT = brown trout
FWD = freshwater drum
LT = lake trout
GZS = gizzard shad
WB = white bass;
RBT = rainbow trout
WP = white perch;
LWF = lake whitefish

The distribution of warm water species among the 3 m depth contour locations during the upwelling differed from that observed a few days later. A few warm water species occurred at the discharge locations during the upwelling but were more numerous afterward (Table 6). White sucker appeared to concentrate in the Duffin Creek/Simcoe Point nearshore area during the upwelling, possibly seeking warm water. High discharge flow rates may have prevented some warm water species (particularly white sucker) from seeking refuge in the immediate thermal discharge areas during the intrusion of cold water into the nearshore zone. A recent study of fish residency in generating station discharges concluded that the entry of cold bottom water into the area surrounding Pickering NGS caused brown bullhead to move into Frenchman's Bay (see Figure 1) to avoid the cold water (Lawler, Matusky and Skelly Engineers, 1981).

It is important to note that the results of this study are inconclusive with respect to the possible movement of fish upstream in a thermal plume during cold water intrusion. Apart from the inshore movement of cold water species and the possible relocation of some warm water species into creeks and shallow bays, at least two other responses of fish to an upwelling appear feasible. Some warm water species may remain inactive on the bottom while others may temporarily move offshore with warm surface waters. These responses could reduce the potential for interaction of warm water fish species with thermal discharges (and with gill nets set on the lake bottom) during periods of upwelling.

3.2 Whitefish Survey

Forty-five (45) round whitefish were taken in gill nets during the fall-spawning fish survey. The total catch was 122 fish and included 13 brown trout, three rainbow trout and one lake trout (Table 7).

3.2.1 Distribution of Round Whitefish

Round whitefish were generally more numerous at the Thickson Point sampling locations than at the Whitby West locations (Table 7). The maximum catch per unit effort of round whitefish was recorded on December 8 at the 7 m depth contour of the Thickson Point transect (CUE = 13). The CUE obtained inshore of the 7 m depth contour on the same date was 11 fish. CUE values were similar at the two locations possibly because the inshore gill net was set from the 4 m depth contour instead of the 3 m depth contour, resulting in a fishing depth of 4 - 5 m

Table 7

Summary of Catch Per 24 h Gill Net Set
During Pickering NGS 'B' Fall Spawning Fish Survey, 1983

	December 8				
	Thickson Point		Whitby West		
	3 m Depth Contour	7 m Depth Contour	3 m Depth Contour	7 m Depth Contour	Total
Round Whitefish	11	13	1	3	28
White Sucker	0	1	2	4	7
Brown Trout	1	0	3	0	4
White Bass	0	0	0	2	2
Carp	0	0	1	0	1
Gizzard Shad	0	1	0	0	1
Total	12	15	7	9	43
	December 9				
Round Whitefish	1	1	3	1	6
White Sucker	5	0	6	4	15
Brown Trout	0	1	1	3	5
Rainbow Trout	1	0	0	0	1
Lake Trout	0	0	0	1	1
Total	7	2	10	9	28
	December 14				
Round Whitefish	4	4	0	3	11
White Sucker	19	4	4	5	32
Brown Trout	0	2	0	2	4
Rainbow Trout	0	0	1	1	2
Yellow Perch	0	0	1	1	2
Total	23	10	6	12	51
Grand Total					122

NB - Gill net set nearest to shore off Thickson Point and retrieved on December 8 was set from the 4 m contour instead of the 3 m contour due to very rough weather conditions.

(Table 7). Since the CUE of round whitefish obtained at this unplanned sampling depth contour approached that at the 7 m depth contour, it is reasonable to conclude that a prespawning aggregation occurred between the 4 m and 7 m depth contours off Thickson Point.

The mean bottom water temperature was 3.6°C on December 8 and was therefore within the range that spawning probably occurs (Table 8). However, all but three of the round whitefish caught along the Thickson Point transect on December 8 were ripe males, suggesting that the majority of females were spatially segregated from the prespawning males at that time (Table 8). Few round whitefish were captured on December 9, and on December 14 when the bottom water temperature was 2.1°C, a total of 11 fish was captured (Table 8). Male round whitefish still outnumbered females (which were mature but not quite ripe) on the December 14 sampling occasion.

No round whitefish eggs were found in the stomachs of any of the white sucker or round whitefish examined during the fall.

3.2.2 Age and Growth of Round Whitefish

Fifty-nine (59) round whitefish were aged, including 14 fish caught during the November portion of the regular fishing sequence. The age composition of these fish is presented in Table 9.

Fish aged 4+ and 5+ dominated the catch of round whitefish in the fall. These age classes have consistently formed the bulk of the fall round whitefish catch for the past three years (1981-1983) (OHRD Report Nos 82-539-K, 83-435-K and this study). Year classes 1976 through 1981 were represented in the 1983 fall catch (Table 9).

Growth of round whitefish was examined by back-calculation of fork lengths at each scale annulus (Table 10). No unusual trends were observed in the growth data, which was similar to that obtained in 1982 (OHRD Report No 83-435-K). The mean back-calculated fork length of one-year-old fish decreased substantially between fish captured at ages 2 and 3 (Table 10). A similar phenomenon was observed in the 1982 back-calculated growth data for fish captured at ages 1 and 2 (OHRD Report No 83-435-K).

Table 8

Distribution of Round Whitefish by Depth and Sex
During Pickering NGS 'B' Fall-Spawning Fish Survey, 1983

Date	Mean Bottom Temperature (°C)	Thickson Point				Whitby West			
		3 m Depth Contour		7 m Depth Contour		3 m Depth Contour		7 m Depth Contour	
		M	F	M	F	M	F	M	F
Dec 8	3.6	10	1	11	2	*	*	2	1
Dec 9	3.2	1	0	1	0	2	1	0	1
Dec 14	2.1	3	1	4	0	0	0	1	2

M = male; F = female

NB - 35 males were ripe; 1 male was immature; all 9 females were mature but not ripe.

* - one fish occurred at this location but was not sexed.

Table 9

Age Composition of Round Whitefish Captured During the Fall
Pickering NGS 'B', 1873

	Age (Years +)						
	2+	3+	4+	5+	6+	7+	Total
No of Fish	7	7	21	17	5	2	59
Year Class	1981	1980	1979	1978	1977	1976	

Table 10

Mean Back-Calculated Fork Lengths (mm) at Each Scale Annulus for Round Whitefish Captured During November and December - Pickering NGS 'B', 1983

Annulus	Age at Capture (Sample Size)					
	7 (2)	6 (5)	5 (17)	4 (21)	3 (7)	2 (7)
7	409.4					
6	396.8	422.0				
5	374.8	403.1	371.6			
4	357.2	375.4	347.7	347.1		
3	321.9	335.1	308.1	311.9	301.8	
2	266.6	269.7	251.1	255.2	249.2	268.4
1	189.2	199.9	188.5	189.8	182.2	192.4

4.0 SUMMARY

During regular survey fishing conducted between Pickering NGS 'A' and Simcoe Point 12 501 fish representing 34 species were collected. The distributions of most fish species in the Pickering NGS nearshore zone were not indicative of a higher relative abundance in the discharge areas. However, gizzard shad were captured in greatest numbers at the 3 m depth contour of the Pickering NGS 'A' discharge transect in November, and white perch were prominent along the 3 m depth contour, particularly at the Pickering NGS 'A' discharge location in May and August. In addition, brown trout catch per unit effort was highest in May at the 3 m depth contour of the Pickering NGS 'A' discharge transect.

The catch per unit effort of lake trout was also high at this location, but was equally high at the 3 m depth contour of the Simcoe Point transect in November. The maximum catch per unit effort of round whitefish occurred at the 12 m depth contour of the Pickering NGS 'A' discharge transect in August, a result which was possibly associated with the inshore movement of cold water fish species during an August upwelling period. However no fish concentrations were observed at the inshore sampling locations of either the Pickering NGS 'A' or 'B' discharge transects during the period of cold water intrusion into the nearshore zone.

A total of 122 fish was collected during the fall-spawning fish survey. Forty-five (45) round whitefish were taken, with most being netted at Thickson Point (4 - 7 m depth contour) on December 8, 1983. The male-to-female sex ratio of round whitefish was about 3.9:1.

The ages of all round whitefish captured during the fall (November and December) ranged from 2+ to 7+, with age-groups 4+ and 5+ exhibiting the highest frequencies. The pattern of growth of round whitefish was similar to that observed in 1982.

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Appendix 1g
1.2m Trap Net Catch Records:
Pickering NGS 'B' 1983

LOCATION	PKAE	PKAE	PKAE	PKAE	PKAE	PKAE	PKAW	PKAW	PKAW	PKAW	PKAW	PKAW
DATE	05/10	05/11	08/02	08/03	11/02	11/03	05/10	05/11	08/02	08/03	11/02	11/03
ALEWIFE	1287	774	16	0	0	0	355	23	0	1	0	0
GIZZARD SHAD	0	0	0	0	3	0	0	0	0	0	1	0
WHITE SUCKER	27	11	0	1	6	0	1	0	0	0	1	0
CARP	0	0	0	0	2	1	0	0	0	0	0	1
BROWN BULLHEAD	4	7	117	51	12	42	0	0	1	1	10	17
EEL (AMERICAN)	2	0	0	0	0	0	0	0	0	0	0	0
WHITE PERCH	0	0	2	11	1	4	0	0	0	0	0	4
WHITE BASS	0	0	0	0	0	5	0	0	0	0	0	0
ROCK BASS	0	0	0	0	1	0	0	0	0	0	0	1
PUMPKINSEED	0	0	0	0	1	0	0	0	0	0	2	1
SMALLMOUTH BASS	0	0	0	4	0	1	0	0	0	0	1	0
BLACK CRAPPIE	0	0	0	0	0	1	0	0	0	0	0	0
YELLOW PERCH	0	0	0	0	2	4	0	0	0	1	0	0
WALLEYE	0	0	0	0	0	0	0	0	0	0	1	0

LOCATION	PKBE	PKBE	PKBE	PKBE	PKBE	PKBW	PKBW	PKBW	PKBW	PKBW	PKBW	PKBW
DATE	05/10	05/11	08/02	08/03	11/02	05/10	05/11	08/02	08/03	11/02	11/03	11/03
ALEWIFE	204	170	6	16	0	25	12	0	0	0	0	0
RAINBOW SMELT	0	1	0	0	0	0	0	0	0	0	0	0
WHITE SUCKER	7	1	3	1	0	0	0	8	3	0	0	0
BROWN BULLHEAD	4	0	25	27	0	0	0	3	9	0	0	0
WHITE PERCH	0	0	0	0	0	0	0	0	1	0	0	0
ROCK BASS	0	0	1	0	0	0	0	0	0	0	0	0
YELLOW PERCH	0	0	0	0	0	0	0	2	0	0	0	0

LOCATION	PKDCE	PKDCE	PKDCE	PKDCE	PKDCE	PKDCE	PKDCW	PKDCW	PKDCW	PKDCW	PKDCW	PKDCW
DATE	05/10	05/11	08/02	08/03	11/02	11/03	05/10	05/11	08/02	08/03	11/02	11/03
ALEWIFE	20	3	90	0	0	0	2	1	0	9	0	0
RAINBOW SMELT	0	0	0	0	0	0	1	0	0	0	0	0
WHITE SUCKER	1	1	0	0	16	12	5	4	0	11	4	5
CARP	0	0	0	6	0	1	0	0	0	3	0	2
BROWN BULLHEAD	10	1	1	4	1	1	13	0	12	77	1	2
WHITE PERCH	0	0	0	0	0	0	0	0	0	1	2	0
WHITE BASS	0	0	0	0	0	0	0	0	0	0	1	0
ROCK BASS	0	0	0	0	0	0	1	0	0	0	0	0
YELLOW PERCH	0	0	0	0	1	1	0	0	3	0	0	0
WALLEYE	0	0	0	0	0	0	0	0	0	0	1	0

LOCATION	PKSE	PKSE	PKSE	PKSE	PKSE	PKSE	PKSW	PKSW	PKSW	PKSW	PKSW	PKSW
DATE	05/10	05/11	08/02	08/03	11/02	11/03	05/10	05/11	08/02	08/03	11/02	11/03
ALEWIFE	418	7	9	3	0	0	11	3	17	10	0	0
RAINBOW SMELT	0	0	0	0	1	0	0	0	0	0	0	0
WHITE SUCKER	6	6	0	1	3	0	8	1	0	2	4	4
CARP	0	0	1	0	0	0	0	0	1	0	0	0
BROWN BULLHEAD	8	0	60	13	0	1	29	2	16	62	0	4
WHITE PERCH	0	0	0	1	0	0	0	0	0	0	0	0
ROCK BASS	0	0	0	0	0	0	1	0	0	0	0	0
SMALLMOUTH BASS	0	0	0	0	0	0	1	0	0	0	0	0
YELLOW PERCH	0	0	0	0	0	0	1	0	0	0	0	0

PKAE Pickering NGS 'A' Discharge East
PKAW Pickering NGS 'A' Discharge West
PKBE Pickering NGS 'B' Discharge East
PKBW Pickering NGS 'B' Discharge West
PKDCE Duffin Creek East
PKDCW Duffin Creek West
PKSE Simcoe Point East
PKSW Simcoe Point West

LOCATION	PHA13	PHA13	PHA13	PHA13	PHA13	PHA13	PHA3	PHA3	PHA3	PHA3	PHA3	PHB13
DATE	05/04	05/05	06/10	06/12	11/03	11/03	04/05	06/10	06/16	11/03	11/03	05/04
DURATION	24	24	24	48	24	24	48	24	24	24	24	24
NO. NETS	8	8	8	8	8	8	8	8	8	8	8	8
ALEWIFE	102	231	43	46	0	0	826	0	0	0	0	313
GIZZARD SHAD	0	0	0	0	0	0	0	0	0	146	2	0
RAINBOW TROUT	0	0	0	0	0	0	1	0	0	0	0	0
BROWN TROUT	0	0	0	1	0	1	22	0	0	0	0	0
LAKE TROUT	4	3	1	1	0	1	15	0	0	0	2	2
LAKE WHITEFISH	0	1	0	0	0	0	3	0	0	0	1	0
ROUND WHITEFISH	4	3	14	2	1	0	5	0	0	3	0	0
RAINBOW SMELT	1	10	0	41	0	0	21	0	0	0	0	7
WHITE SUCKER	1	1	0	15	3	2	15	3	0	0	0	3
LAKE CHUB	0	0	0	1	0	0	0	0	0	0	0	0
CARP	0	0	0	0	0	0	0	0	0	2	1	0
BROWN BULLHEAD	0	0	0	0	0	0	0	2	1	0	0	0
WHITE PERCH	0	0	0	0	0	0	3	0	15	3	3	0
WHITE BASS	0	0	0	0	0	0	0	0	2	0	0	0
SMALLMOUTH BASS	0	0	0	0	0	0	0	0	7	0	0	0
YELLOW PERCH	0	0	0	0	0	0	3	0	1	7	3	0
WALLEYE	0	0	0	0	0	0	0	0	0	1	0	0

LOCATION	PHB13	PHB13	PHB13	PHB13	PHB13	PHB3	PHB3	PHB3	PHB3	PHB3	PHB3	PHDC13
DATE	05/05	06/10	06/12	11/02	11/03	05/04	05/11	06/10	06/16	11/03	11/03	05/04
DURATION	24	24	48	24	24	24	24	24	24	24	24	24
NO. NETS	8	8	8	8	8	8	8	8	8	8	8	8
ALEWIFE	121	89	36	1	1	389	85	13	0	0	1	88
GIZZARD SHAD	0	0	0	0	0	0	0	1	1	7	0	0
COHO SALMON	0	0	0	0	0	0	0	0	0	0	1	0
RAINBOW TROUT	0	0	0	0	0	0	1	0	1	1	0	0
BROWN TROUT	0	0	0	0	0	0	1	0	0	0	0	0
LAKE TROUT	1	7	2	1	1	3	1	0	0	1	0	3
LAKE WHITEFISH	0	0	2	0	0	0	1	0	0	0	0	0
ROUND WHITEFISH	0	0	0	1	0	1	0	0	0	0	0	1
RAINBOW SMELT	16	6	6	0	0	0	0	0	0	0	0	37
NORTHERN PIKE	0	0	0	0	0	0	0	0	0	1	0	0
WHITE SUCKER	0	0	11	1	2	0	1	0	3	5	0	0
WHITE PERCH	0	0	0	0	1	0	0	3	3	3	1	2
WHITE BASS	0	0	0	0	0	0	0	0	0	2	0	0
YELLOW PERCH	0	0	1	0	0	0	0	2	15	0	1	1
FRESHWATER DRUM	0	0	0	0	0	0	1	0	0	0	0	0

LOCATION	PHDC13	PHDC13	PHDC13	PHDC13	PHDC13	PHDC3	PHDC3	PHDC3	PHDC3	PHDC3	PHDC3	PHE13
DATE	05/05	06/10	06/12	11/02	11/03	05/04	05/05	06/10	06/16	11/03	11/03	05/04
DURATION	24	24	48	24	24	24	24	24	24	24	24	24
NO. NETS	8	8	8	8	8	8	8	8	8	7	8	8
ALEWIFE	218	20	13	1	1	1107	1894	0	64	0	2	0
GIZZARD SHAD	0	0	0	0	0	0	0	0	12	0	0	0
CHINOOK SALMON	0	0	1	0	0	0	0	0	0	0	0	0
RAINBOW TROUT	0	0	1	0	0	0	0	1	1	1	3	0
BROWN TROUT	0	0	0	2	0	2	2	0	2	0	0	0
LAKE TROUT	1	4	0	2	3	1	0	1	0	1	1	0
ROUND WHITEFISH	1	1	1	2	1	0	0	0	0	0	1	1
RAINBOW SMELT	27	1	1	0	0	39	5	0	0	0	1	0
LONGNOSE SUCKER	0	0	0	0	0	0	1	0	0	0	0	0
WHITE SUCKER	2	0	7	2	3	33	8	46	2	41	22	0
CARP	0	0	0	1	0	0	0	0	2	0	1	0
BROWN BULLHEAD	0	0	1	0	0	0	0	0	3	0	0	0
WHITE PERCH	1	1	0	1	0	0	0	0	1	2	0	0
WHITE BASS	0	0	0	0	0	0	0	0	0	1	1	0
YELLOW PERCH	0	0	0	0	0	0	0	0	0	0	0	0
WALLEYE	0	0	0	0	0	0	0	0	0	1	1	0

LOCATION	PHE13	PHE13	PHE13	PHE13	PHE13	PHE3	PHE3	PHE3	PHE3	PHE3	PHE3
DATE	05/05	06/10	06/12	11/03	11/03	05/04	05/05	06/10	06/16	11/03	11/03
DURATION	24	24	48	24	24	24	24	24	24	24	24
NO. NETS	8	8	8	8	8	8	8	8	8	8	8
ALEWIFE	290	54	64	0	0	918	348	35	93	0	1
GIZZARD SHAD	0	2	0	0	0	0	0	1	2	0	0
RAINBOW TROUT	0	0	1	0	0	0	0	0	0	1	0
BROWN TROUT	0	0	1	0	1	2	0	0	0	4	0
LAKE TROUT	2	3	3	1	1	3	0	0	0	12	3
LAKE WHITEFISH	0	0	1	0	0	0	0	0	0	0	0
ROUND WHITEFISH	0	0	0	1	0	0	1	0	0	0	1
RAINBOW SMELT	36	1	0	0	0	22	12	0	0	0	0
LONGNOSE SUCKER	0	0	0	0	0	2	0	0	0	0	0
WHITE SUCKER	0	0	17	3	1	20	3	16	4	0	2
LAKE CHUB	0	0	0	0	0	0	1	0	0	0	0
BROWN BULLHEAD	0	0	0	0	0	0	0	1	0	0	0
SUNFISH (AMERICIAN)	0	0	0	0	0	0	0	0	0	0	0
WHITE PERCH	0	0	0	0	0	0	0	0	0	0	0
WHITE BASS	0	0	0	0	0	0	0	0	1	1	2
ROCK BASS	0	0	0	0	1	0	0	0	0	0	0
SMALLMOUTH BASS	0	0	0	1	0	0	0	0	0	0	0
YELLOW PERCH	0	0	0	0	0	1	0	0	0	0	0
FRESHWATER DRUM	0	0	0	0	0	0	0	0	1	0	0

PHA3 Pishering NHS 'A' Discharge 3 m Contour
PHA13 Pishering NHS 'A' Discharge 13 m Contour
PHB3 Pishering NHS 'B' Discharge 3 m Contour
PHB13 Pishering NHS 'B' Discharge 13 m Contour
PHDC3 Duffin Creek 3 m Contour
PHDC13 Duffin Creek 13 m Contour
PHE3 Simcoe Point 3 m Contour
PHE13 Simcoe Point 13 m Contour

Appendix 2

Common and Scientific Names of Fish Species Collected at Pickering NGS 'B' - 1983

Common Name	Scientific Name
Alewife	*Alosa pseudoharengus*
Brown Bullhead	*Ictalurus nebulosus*
Rainbow Smelt	*Osmerus mordax*
White Sucker	*Catostomus commersoni*
Emerald Shiner	*Notropis atherinoides*
Gizzard Shad	*Dorosoma cepedianum*
Yellow Perch	*Perca flavescens*
White Perch	*Morone americana*
Spottail Shiner	*Notropis hudsonius*
Carp	*Cyprinus carpio*
Round Whitefish	*Prosopium cylindraceum*
White Bass	*Morone chrysops*
Longnose Dace	*Rhinichthys cataractae*
Smallmouth Bass	*Micropterus dolomieui*
Walleye	*Stizostedion vitreum*
Rock Bass	*Ambloplites rupestris*
Brown Trout	*Salmo trutta*
Logperch	*Percina caprodes*
Rainbow Trout	*Salmo gairdneri*
Slimy Sculpin	*Cottus cognatus*
Lake Chub	*Couesius plumbeus*
Longnose Sucker	*Catostomus catostomus*
Johnny Darter	*Etheostoma nigrum*
American Eel	*Anguilla rostrata*
Coho Salmon	*Oncorhynchus kisutch*
Lake Trout	*Salvelinus namaycush*
Chinook Salmon	*Oncorhynchus tshawytscha*
Lake Whitefish	*Coregonus clupeaformis*
Freshwater Drum	*Aplodinotus grunniens*
Northern Pike	*Esox lucius*
Bluntnose Minnow	*Pimephales notatus*
Pumpkinseed	*Lepomis gibbosus*
Fathead Minnow	*Pimephales promelas*
Black Crappie	*Pomoxis nigromaculatus*

Appendix 3

Results of ANOVA Tests

1. 2-Way ANOVAs for Trap Net Data (Month x Location)
NB - Only Significant ($P < 0.05$) Results Presented

Species	Main Effect	F Ratio	Interactions
Brown Bullhead	Date	6.91	None
White Perch	Location	3.10	None
Alewife	Date Location	3.23 7.40	Date x Location
White Sucker	None	-	None

2. 3-Way ANOVAs for Gill Net Data (Month x Location x Depth)
NB - Only Significant ($P < 0.05$) Results Presented

Species	Main Effect	F Ratio	Interactions
Alewife	Depth Date	15.12 43.88	All Interactions Significant
Smelt	Date	14.93	None
Gizzard Shad	None	-	None
Lake Trout	None	-	Location x Date; Depth x Date
Round Whitefish	None	-	None
Brown Trout	Location Depth Date	3.54 13.94 26.17	Location x Depth Location x Date Depth x Date
White Perch	Depth	9.84	Location x Depth
White Sucker	Depth	3.13	Location x Depth

Appendix 4

Bottom Temperatures (°C) Recorded During Regular Gill Net Fishing Periods

	Depth Contour	May		August			November	
		4	5	10	12	16	2	3
Pickering NGS 'A' Discharge	3 m	-	13.0	19.0	-	27.1	7.3	7.3
	12 m	5.3	5.4	13.5	18.5	-	7.0	7.5
Pickering NGS 'B' Discharge	3 m	8.2	8.3	15.3	-	21.5	7.6	8.2
	12 m	5.6	5.4	15.5	19.0	-	7.3	7.6
Duffin Creek	3 m	7.7	6.4	14.6	-	22.6	7.5	7.6
	12 m	5.0	5.6	11.4	18.8	-	7.6	7.6
Simcoe Point	3 m	6.9	6.8	14.8	-	22.3	7.5	7.8
	12 m	5.1	5.3	10.5	19.0	0	7.5	7.6